

PREPARING FOR A SEA CHANGE IN GLOBAL REFINING

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IN RECENT YEARS, THE global oil refining industry has been buffeted by many events—China’s pursuit of energy self-sufficiency, the crude oil price advantage for US refiners, and diesel’s increasing popularity as a replacement for gasoline are just a few. These events have had significant implications, but it is likely that they will pale in comparison with the effects of the sulfur regulations that have been adopted by the International Maritime Organization (IMO): beginning in 2020, the sulfur content in marine fuel will be limited to 0.5%.

Although the IMO’s objectives are laudable—to continue reducing harmful airborne emissions from ships—we expect that the implementation of the regulation will cause an oversupply of high sulfur fuel oil (HSFO) as we approach 2020, severely disrupting the refining industry worldwide. This disruption may extend through 2025 or even longer, as most industry players delay making the investments needed to reignite demand for HSFO and normalize prices.

But this scenario is not a given. Refiners can limit their downside—or even emerge as winners—if they review their strategies and take action now.

Widespread Disruption

About 90% of the marine fuel sold is 3.5% sulfur. This equates to 3 million to 4 million barrels of HSFO per day or about half of global HSFO production. The IMO ruling that requires ships to use marine fuel with no more than 0.5% sulfur will eliminate part of that demand, potentially causing a glut of nearly 2 million barrels per day. This, in turn, could prompt industry-wide disruption in two main areas: product pricing and refinery profitability.

HSFO pricing has been at its higher value because of a tight supply of heavy residue streams for nonswitchable demand, such as upgrading residual oil; these streams are conversion feedstock and thereby set the price. A loosening in worldwide supply by approximately 2 million barrels could cause HSFO to shift to its lower value—a

price determined by switchable demand and competition with other fuel options. (See Exhibit 1.)

At the same time, the price of low sulfur fuel oil (LSFO) and distillates, which can be used to create compliant fuel oil blends, will increase. We expect the situation to be analogous to the introduction of low-sulfur regulations for on-road vehicles by the US Environmental Protection Agency in 2006: about a year before the ruling took effect, the price of low-sulfur products skyrocketed. (See Exhibit 2.)

A shift in HSFO pricing from its higher value to its lower value could have a significant knock-on effect on the price differential between light and heavy refined products. Specifically, we expect a spike in the differential. Which refineries are profitable and emerge as leaders will depend on their capabilities and product mix.

Complex refineries with hydrocracking and residue desulfurization units that enable maximizing LSFO and distillates production will be able to navigate the disruption. Asia and the Middle East are home to such refineries. Additionally, refineries with coker units, such as those on the US Gulf Coast,

will fare well, as will refiners with access to crude with very low sulfur.

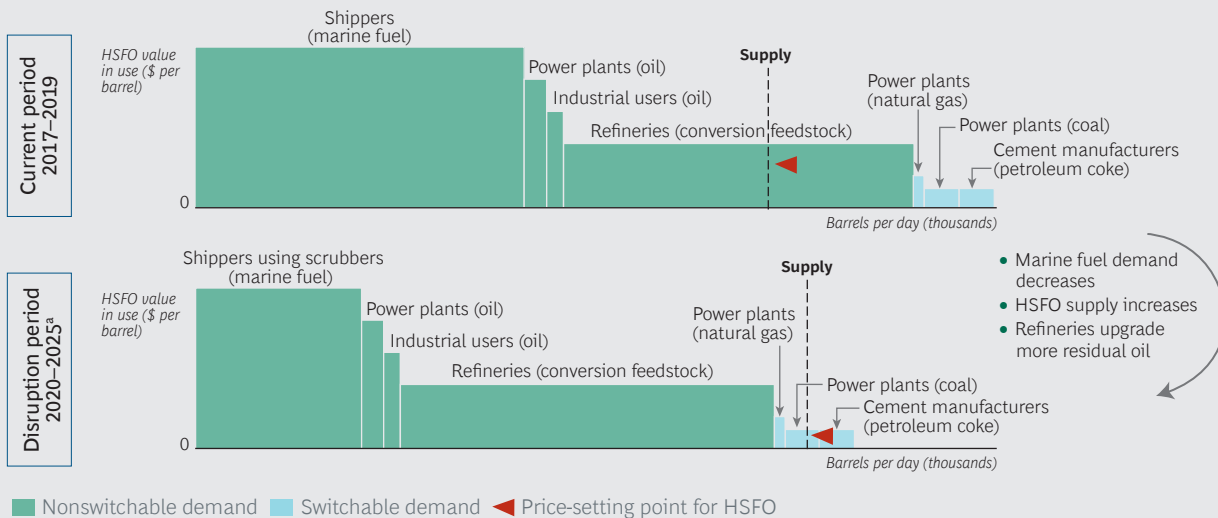
Simple refiners that produce mostly HSFO (such as the high-sulfur hydroskimming and topping refineries in Russia) and those whose products have low distillate yields (such as the pure-play gasoline refineries that are based in parts of Northwest Europe and on the US East Coast) will find it very difficult to maintain profitability in the new environment. (See the sidebar “The Impact on Gasoline Refineries.”)

The location of refineries may also affect profitability. Historically, HSFO prices have been lower in Northwest Europe than in the US Gulf Coast and Singapore, which are larger hubs for marine refueling and home to more residue conversion facilities, creating higher demand. However, for distillates, the US Gulf Coast has a price advantage over other regions, owing to the relatively lower demand. Shippers may therefore prefer to source distillate fuel from the US, benefiting US refiners at the expense of European ones.

The sulfur content of crude oil also varies widely by region: very low-sulfur crudes are located mainly in West Africa and in

EXHIBIT 1 | Switchable Demand and Competition Will Set HSFO Price

DEMAND CURVE FOR HEAVY REFINED PRODUCTS

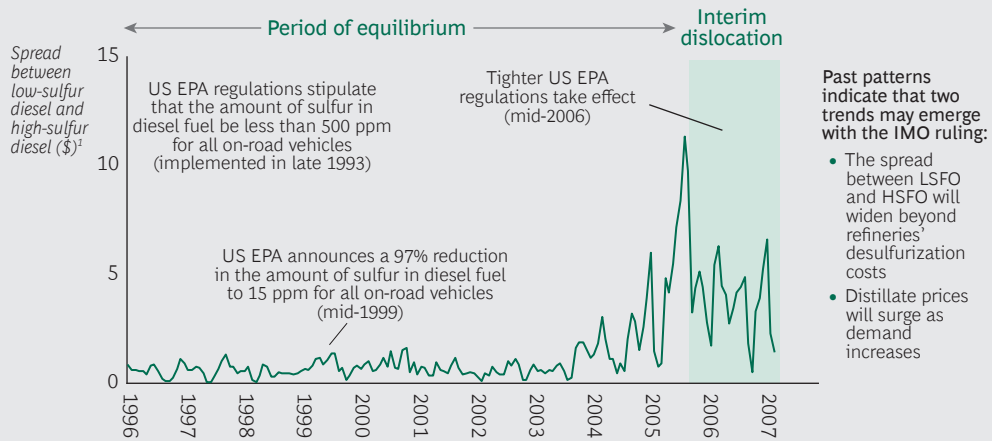


Source: BCG analysis.

Note: HSFO = high sulfur fuel oil. Scales in the exhibit are notional.

^aThe disruption period may last longer, depending upon the actions of the ship owners, shippers, and refiners.

EXHIBIT 2 | US Regulations Caused Prices for Low-Sulfur Products to Spike



Source: US Energy Information Administration.

Note: US EPA = US Environmental Protection Agency; ppm = parts per million; IMO = International Maritime Organization; LSFO = low sulfur fuel oil; HSFO = high sulfur fuel oil.

¹US Gulf Coast.

the US, whereas other areas, such as the Middle East, have high-sulfur crudes. The IMO ruling will cause the price spread to widen between low-sulfur sweet crudes and high-sulfur sour crudes. These differences in crude prices will be directly reflected in refinery profitability.

Assessing the Shipping Industry's Options

Given that it is the responsibility of ship owners and shippers to comply with the IMO ruling, some refiners may take a wait-and-see approach. However, refiners that want to emerge from the disruption relatively quickly and unscathed—or even a winner—will be proactive. (See the sidebar “IMO Compliance in the Shipping Indus-

try.”) They will examine the options available to ship owners and shippers, anticipate how the various solutions could affect their refining business, and look for opportunities.

Scrubbers. Although the low-sulfur regulations call for the use of compliant fuel oil, the IMO is permitting ships to meet its emission standards by using scrubbers. These systems are fitted onto a ship's exhaust to remove sulfur-oxide from effluent gas by mixing it with alkaline water. Installing a scrubber takes about six months, but it requires ship owners to make a high capital outlay: \$2 million to \$3 million to retrofit a vessel. When buying a ship, including a scrubber in the specifications boosts the price by \$1 million to

THE IMPACT ON GASOLINE REFINERIES

BCG's Global Refining Model suggests that pure-play gasoline refiners with fluid catalytic cracking (FCC) units and reformers will be negatively affected throughout the disruption. To meet demand, refiners that can convert residual oil and manufacture distillates will inevitably use delayed cokers, which are coproduction units that produce gasoline as well as distillates. Gasoline

refiners will attempt to counteract the additional gasoline production by running gasoline-generating FCC units at lower utilization rates. Despite this, the increase in supply will cause prices to fall further in markets where gasoline prices are already weakening from an oversupply. North America and Europe are two such markets.

IMO COMPLIANCE IN THE SHIPPING INDUSTRY

Major shipping companies have formed an industry group, the Trident Alliance, to support the robust and transparent enforcement of the new IMO regulations. Although we expect a degree of noncompliance as some shippers continue to use HSFO without scrubbers, particularly in the beginning, most will comply. The IMO plans to implement stringent

procedures to ensure compliance, including taking fuel oil samples and using helicopters to test stack gas emissions from vessels in operation. Penalties as severe as a complete vessel ban on a specific marine route are being discussed. This is a risk most shippers will not take.

\$2 million. Unfortunately, the ruling comes at a time when the shipping sector is financially weak because of low fleet utilization, anemic charter rates, and a widespread cash crunch. The scrubber option, therefore, presents a challenge for ship owners.

For shippers, scrubbers are an attractive option. Shippers would be able to continue using HSFO, which will be less expensive than compliant fuel. The savings would not only offset the higher day rates that ship owners would likely charge to recover their investment but also cover the additional cost of handling effluent sour water from a closed-loop system. (We expect that the IMO will prohibit sour water discharging, even in highly alkaline ocean waters.)

Currently, scrubbers are installed on less than 1% of ships worldwide, and industry analysts predict that adoption is unlikely to exceed 25% by 2020. Given this and the financial challenges, refiners should expect ship owners to wait to see whether refiners will adopt alternative solutions at scale before pressing ahead with scrubber investments.

Liquefied Natural Gas. The use of liquefied natural gas (LNG) as marine fuel has benefits: when compared with HSFO, LNG has zero emissions and a cheaper price. However, this option would require significant investment not only by ship owners but also by some port authorities. Vessel engines would have to be converted so that they could burn LNG, and LNG terminals would have to be built or expanded.

Ship owners could increase shipper day rates to recoup their investment, but that strategy could have its challenges. In addition to a weak shipping economy, such ships may represent an opportunity cost to shippers: LNG tanks take up much more space than those for other bunker fuels, leaving less room for cargo. Furthermore, leasing such ships will not be an option for shippers that use smaller ports with no LNG terminals.

The adoption of LNG would directly impact refiners by keeping the demand for HSFO low, but the implementation obstacles make it a less likely choice, particularly to counter the disruption that could start as we approach 2020.

Distillates as Fuel. Middle distillates that serve as road fuel provided a key solution in 2015 when the IMO imposed a low sulfur limit for emission control areas (low-emission zones along the coasts of North America and in Western Europe). Some studies have suggested that distillates could be ship owners' and shippers' first choice this time as well, but we disagree for two reasons:

- The IMO regulation applies to all open waters. Relying solely on distillates as fuel would normally be very costly for shippers, and the increase in demand will push the price even higher.
- The use of distillates would require a capital expenditure by ship owners to make fuel oil-based engines compatible with lower-viscosity distillates.

Distillates may be used as fuel by some ship owners and shippers seeking to comply with the IMO ruling, but distillates are unlikely to be the sole or primary option.

Positioning to Win

Lacking any compelling options, we expect ship owners to delay investing, leaving refiners with several opportunities to ensure their profitability in the short and medium terms.

Create compliant fuel blends through refinery optimization. Using distillates is typically the most expensive way to produce compliant fuel, and as a result, such fuel will become the marginal supply source that sets the price of compliant fuel. Refiners that use intermediate residue streams, such as hydrotreated vacuum gas oil, will benefit by realizing a higher price at a lower cost than refiners that use distillates. (See Exhibit 3.)

Invest in residue desulfurization units. The investment case for desulfurization units is attractive for refiners. LSFO, which can be used as a compliant fuel, will be priced at a significant premium by 2020. Refiners may also consider investing in cokers and hydrocrackers. However, the capital expen-

diture for residue desulfurization units is slightly lower, and they offer more flexibility: when price differentials are wide between light refined products and heavy refined products, desulfurization units can produce more distillates to maximize profits; conversely, when price differentials are narrow, these units can function as fuel oil hydrotreaters, producing compliant fuel.

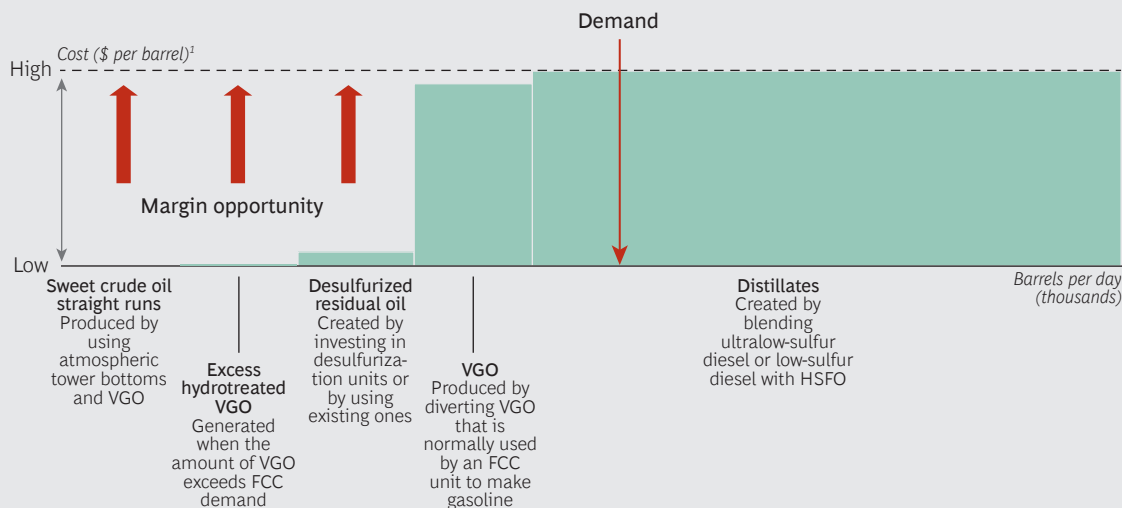
Despite the benefits, there are drawbacks. Although the capital outlay for a desulfurization unit is lower than it is for a coker or hydrocracker, it is still high at about \$900 million. In addition, refining returns are volatile, and the time required to bring these units online can be up to five years. To be ready by 2020, projects should be underway by now.

However, refiners could make smaller investments in auxiliary units, such as sulfur and amine gas-treating units. Because these increase a refiner's capacity to remove sulfur from its products, require less capital, and come online more quickly, they will be highly profitable in the disruption period.

Partner with ship owners. Pursuing innovative partnerships with ship owners is another opportunity. Refiners and ship

EXHIBIT 3 | Nondistillate Refining Routes May Have Better Margins

SUPPLY CURVE FOR COMPLIANT FUEL



Source: BCG analysis.

Note: VGO = vacuum gas oil. FCC = fluid catalytic cracking. HSFO = high sulfur fuel oil. Scales in the exhibit are notional.

¹Boosting supply will require a spread between the cost of fuel oil with 0.5% sulfur and the cost of fuel oil with 3% sulfur.

owners could forge offtake agreements, for example, whereby refiners coinvest in scrubbers, secure the purchase of their HSFO, and mitigate the ship owner's investment. Such agreements are already being explored. For example, Wärtsilä, a maker of marine equipment, recently offered ship owners the option of repaying the cost of scrubber equipment by means of a premium paid on top of the HSFO price.

Optimize the asset portfolio. Refiners should optimize their asset portfolio in anticipation of and during the disruption period. They should consider divesting poorly performing and nonintegrated assets, or, in the absence of buyers, decommissioning

and converting assets into storage terminals. Refiners that produce a high proportion of HSFO or a low proportion of distillates can increase their efficiency and boost margins through asset optimization.

THE IMO RULING may cause significant disruption in the global refining industry. Refiners should examine the potential implications of the low-sulfur regulations carefully, undertake scenario analyses to fully understand the breadth of the potential impact, and take appropriate action. The analyses should be conducted well ahead of 2020. By acting early, refiners can increase their chances of mitigating threats and maximizing profits.

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